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By George Dock, M. D.,
Ann Arbor, Mich.

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By GEORGE DOCK, M. D.,

Ann Arbor, Mich.

I intend to limit myself to a narrow part of the subject, [109] and especially to the practical as distinguished from the scientific or theoretic side.

When we think of vaccination we must remember that if we are not wholly ignorant of the specific germs, we are still unable to make them serve as an index to the purity or quality of material, and we should also remember that we have no methods of dosage, such as make the application of diphtheria antitoxin and tuberculin fairly controllable. We recognize the effects of vaccine by the local results or by the immunity produced. For the former we have a more or less characteristic set of changes, ending in a peculiar and permanent scar. The immunity is not so easy to recognize in single cases, because we cannot tell how effective natural immunity might have been, and we rarely have more than the crudest notion of the degree of danger in a given case. When variolation was practiced the conditions were somewhat different, but with only casual exposure we are obliged to fall back, as proofs, on experiences with large numbers of people, where various degrees of thoroughness of vaccination and various degrees of danger of infection can be considered as neutralized by force of numbers.

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[1] Read before the Johns Hopkins Hospital Medical Society, January 4, 1904.

[109] ## The Material Used.

In the earliest days of vaccination the so-called lymph from vesicles on human beings was used. In Jenner's memorable experiment on James Phipps he used the virus from a cow-pox vesicle on the hand of a dairy-maid, but later he inoculated from a vesicle on the nipple of a cow. After a few transfers this stock died out, as the former had done, but soon after the publication of Jenner's first work several new strains were obtained. Many of these were kept on by inoculating from arm to arm, or indirectly, and so were spread all over the world. It is interesting to remember that in America the virus was introduced by Waterhouse in Boston and Hosack in New York, the Southern States being early supplied by Waterhouse through the interest of President Jefferson. Some of the early vaccine was kept up for a long time. Drake tells us that he could see no change in course or phenomena in that used in the West in the forty-four years following its introduction in 1802. According to Kaposi, the
[110] material in the Vienna Vaccine Institute was descended from some sent by Jenner to De Carro in 1802, and retained its efficiency in the late 80's. But it did not always keep so well. L. Pfeiffer mentions some that he saw a few years ago, of the same origin, so degenerated that it gave only a minimal areola and the scab dropped off on the 13th day.

Even in the first few years after Jenner's announcement the degeneration of virus was often observed, and the search for new cow-pox virus was made. It became more lively in the 20's, stimulated by the revival of small-pox in many countries, often affecting vaccinated persons. Partly from the incomplete protection thus shown, partly from the imperfect development of the vaccine lesions, it was believed that the material in use was not as potent as it had been in the beginning. But as a result of the lessened prevalence of small-pox, natural cow-pox was much less frequent than in Jenner's time. Rewards were offered in some countries for the discovery of cow-pox. Retro-vaccination, or the inoculation of the cow with human virus, was used for the purpose of reviving the stock. About the same time, that is in the end of the first third of the nineteenth century, the value of revac-

cination became known, though it took many years to be [110]
fairly appreciated, and it is still ignored in some parts of the world.

Experiments for the production of cow-pox, by inoculating animals with small-pox virus, had been made by some in the early part of the century, and these were repeated, and in the hands of Ceeley and especially of Badcock, of Brighton, were successful. Badcock himself vaccinated over 13,000 persons with the virus, and furnished material to many physicians and apothecaries. It is an interesting fact that Dr. W. E. Coale, of Boston, "suspecting the efficiency of the virus then in use," obtained some of Badcock's material. In 1852, Badcock sent him some "crusts from a variolated cow, a glass charged with the same material, and some points charged from a vesicle on a child's arm," caused by some of the primary lymph. Badcock sent Dr. Coale some more material in 1855, though this was not direct from the cow. Drs. Adams, of Waltham, and Putnam, of Boston, repeated Ceeley's experiments successfully, according to a letter by Dr. Coale, dated April 6, 1852, in the *Boston Daily Advertiser.* Other experiments made from the time of Badcock down to a recent period, by various investigators, have demonstrated the possibility of obtaining vaccine virus by variolating cows, and although the results were opposed by Chauveau and his colleagues, their scientific and economic value is now universally recognized, while the occasional propagation of small-pox by vaccination from such animals is explained by obvious errors in technic.

But the great bulk of material used for vaccinating, down to the 70's, was humanized virus, inoculated either from arm to arm or indirectly. In large cities it was not difficult to keep up the succession, though the chief localities for that, foundling asylums, had certain important disadvantages. In the country and in small towns the supply often failed, or gave poor results. The methods used for keeping and inoculating vaccine in this period, other than by operating from arm to arm, are of some interest.

One of the earliest methods of preservation was by drying the lymph, obtained by puncturing a vesicle, on a piece of

[110] glass. This was tied together with another glass and the two kept dry until wanted. Another was to soak threads in the virus, dry them and keep them in bottles. Or the virus was dried on elongated glass stoppers and the stoppers fixed in bottles, or it was dried on lancets, quills, or even thorns. On account of the rusting of steel instruments, with damage to the latter if not to the virus, silver or gilt lancets were used. Needles were used sometimes, and a Dr. Carl, in Prague, invented a forked silver needle. Small glass tubes, such as barometer tubes, were also used, sealed at the ends by fusing. The use of crusts or scabs came comparatively late.

The Early Technic.

There were many modifications of the method of inoculating, though the details were for the most part derived from the earlier small-pox inoculations. Jenner first used short incisions, or punctures. When threads were used, they were cut in short lengths, placed in shallow incisions, and kept there by adhesive plaster. From the fact that some operators renewed the threads on the third day we may assume that the method was not always successful. Sometimes the dried material, on threads, glass or instruments, was softened by soaking in blood, or by exposing to the vapor of boiling water, or soaking in water, or even saliva. More complicated methods of getting an inoculating surface were sometimes followed. Cross-scratching seems to have been a later invention. Fly-blisters were used at an early period, even a skin-trepan was invented, and as late as 1902 a cautery-hammer was devised, for raising a blister, in the cavity of which vaccine was to be inoculated. At various times since the invention of the hypodermic syringe, that instrument has been used for injecting vaccine virus into the skin or subcutaneous tissue. Although it seems to serve the purpose, it has no great advantage, and some disadvantages.

One of the common details of vaccinating developed from the use of humanized virus, viz., the practice of making multiple lesions. It was thought that the taking of part of the lymph lessened the effect on the vaccinifer, and so several vesicles were produced, one at least being untouched. Al-

though the protection afforded by one good vesicle has always [110]
been recognized, there is some reason for believing that protection is in proportion to the area of typical scar.

Bovine Virus.

The growing realization of the inconveniences of humanized virus gradually led to the development of another method, but there were other reasons besides the technical ones. In the 60's the fear of transmitting syphilis by vaccination became intensified, and although investigation showed that the risk was slight, considering the large number of people vaccinated, it also proved that the danger was real.
The possibility of transmitting tuberculosis was also sug- [111]
gested by the work of Villemin, and was for a time much exaggerated. So attention was directed more and more to the use of bovine virus, that is, material raised purposely on the animal. In this way it was thought that the danger of setting up syphilis and tuberculosis could be avoided, and although the fear of transmitting inflammatory diseases was not absent, it did not retard the movement. In fact, then as now, there were some who thought that severe local reactions were desirable.

The use of bovine vaccine goes back directly to Negri, who cultivated virus on animals, in Naples, from 1842. It is said that the same method was begun in Naples early in the century, but prohibited by law. Negri's method and material were introduced in Paris in 1864, by Lanoix, who, however, adopted cow-pox virus from the celebrated spontaneous case discovered at Beaugency, France, in 1866. The method spread rapidly. It was introduced in Brussels in 1865, by Warlomont, and in Berlin, in the same year, by Pissin, and soon afterwards in Vienna. In 1870, Dr. Henry A. Martin, of Boston, an indefatigable investigator and cultivator of vaccine, imported some of the Paris material, just before the strain died out during the siege. For some time after bovine virus came into use, the method of preservation was chiefly that of coating ivory slips with virus obtained by puncturing vesicles, the bases of which were compressed by forceps. Scabs were also used. On the continent of Europe a popular

[111] method consisted in vaccinating directly from the calf, the animal being taken to the domicile or to a central location, as was most convenient.

The Use of Pulp.

At first the material used was the liquid part of the contents of the vesicle, as was necessarily the case in using human virus before the scab stage, but in the 80's the so-called pulp came into use. The reason for the change was complex, and had reference partly to the greater tenacity of the liquid part of the bovine vesicle as compared with that of the human one, and its greater tendency to coagulate. The pulp is the whole vesicle, made up of the cells of the skin in the lesion, leucocytes, red-blood corpuscles, fibrin, fat, specific and non-specific micro-organisms, and debris. Many objections have been made to the use of pulp vaccine, and from time to time these are brought forward in articles, but the arguments advanced are misleading, to say the least. Thus, it is said that pulp contains more pus and more bacteria than the liquid part obtained either by puncture of the vesicle or by tearing off the top of the vesicle and permitting liquid to exude from the base. But at the time the pulp is taken there is no pus in the ordinary sense, and it has never been demonstrated that the whole pulp contains more bacteria, bulk for bulk, than does the liquid part. Careful observations are needed in this connection, but at the present time it should be borne in mind that the best vaccine in every respect, that is, the virus that causes least accidental infections and gives the best protection, is pulp vaccine. By this I mean the virus used over most of Western Europe and in England, and notably in Germany, where the statistics on all the points concerned are most complete.

Many methods of treating the pulp have been experimented with. It is not necessary for my purpose to discuss these, and I shall consider only the method now almost universally used, describing it in some detail from the beginning.

Calves are used, generally from 3 to 6 months old, sometimes younger or older. Females are usually preferred on account of the greater cleanliness of bedding, though some

operators use young bulls, which they inoculate on the scrotum. [111] The animals are examined with reference to soundness, and are sometimes tested with tuberculin, though this is not necessary, as they are usually killed soon after the operation and can then be examined for disease, before the vaccine is distributed. After being under observation a few days the calves are thoroughly cleaned. Just before the operation, the animal selected having been fastened on a suitable table, the abdomen is shaved and washed with soap and warm water. In some institutions sublimate, carbolic acid or other antiseptic is used. A final washing is done with large quantities of sterlized water and the skin dried with sterilized towels. The operators, in sterilized clothing, observe the usual aseptic precautions. A series of incisions is made in the skin of the abdomen, about an inch apart, extending as far forwards as the navel and laterally to the inner sides of the thighs. Sometimes the anterior abdomen, and even the side and back of the body have been used, but the thicker skin in these parts interferes with the best results. If more than slight bleeding follows the incisions it is checked by pressure with sterilized towels. The "seed" vaccine is then spread over the prepared surface with a spatula and allowed to dry. The seed is of various kinds. Sometimes it is bovine virus, selected with care from well-developed vesicles and of tested bacterial purity. Sometimes it is selected humanized vaccine, sometimes material derived more or less remotely from human variola. Often the makers either do not know, or are unwilling to state, the source and nature of the seed, and often misrepresentation has occurred. It is clear that in order to make an accurate study of the effects of vaccination the history of the material used is essential.

Dressings of various kinds have been used to protect the site of operation, but usually they are not considered necessary. The animals are kept in clean stalls, and carefully observed until the time for removal of the material, between the fourth and sixth days. The vesicles are then of fairly good size, but should not show evidences of suppuration. The calf is again fastened on the table, the abdomen thoroughly scrubbed with soap and warm water, rubbed by hand, and

[111] finally washed with sterilized water and dried. This removes the superficial dried epidermic scabs, and does not break the vesicles. For the removal of the pulp the common method is to scrape each row of vesicles with a large curette, though it is said that some still use the forceps to clamp the bases. The
[112] pulp is then made homogeneous by grinding, mixed with 50 per cent glycerine, and kept for several weeks to "ripen."

Up to the early 80's pulp was used according to the earlier methods, but after that great activity was displayed in treating pulp with various antiseptics, the details reminding one of the complicated antiseptic dressings used in general surgery at the same period, but since 1891 the use of glycerinated lymph has been general. The addition of glycerine to vaccine virus is much older. Cheyne employed it as early as 1850 to keep lymph fluid; Mueller in 1866 to increase the bulk; Warlomont patented a method in 1882, and there are dozens of references to its use before him. But Copeman, by a series of careful investigations, showed that glycerinated pulp lost some of the bacteria it originally contained, and that they might even disappear completely at a time when the specific virus was still unimpaired in strength, and since then the method has been adopted by the leading vaccine institutions with little or no modification. Drying the pulp or lymph has a similar action on the bacteria, but glycerine has other advantages, one of the most important being the facility with which tests can be made on the glycerinated pulp, rendered fairly uniform by mixing in special apparatus.

The tenacity of life of the specific germs has long been known to vary much, even under conditions apparently similar. In the glycerine preparations this is also true, but the real state is easy to fix by experiment in any specimen. It has been shown that glycerinated vaccine may be effective as long as a year after removal. Though the usual dilution is slight, from half to several times the weight of pulp being added in 50 per cent sterilized glycerine, dilutions of 1 to 2000 will give good results if carefully used. By the present method one calf will furnish from several hundred to several thousand portions of vaccine, three to four thousand being

not unusual, and perfect vaccination has been obtained from calves giving as much as 15,000 portions. [112]

Copeman has summarized the advantages of glycerinated vaccine, and I quote from him the following:

"1. Great increase in quantity can be obtained without any consequent deterioration in quality, the percentage of insertion success following on its use being equal to that obtained with perfectly active fresh lymph.

"2. It does not dry up rapidly, as does unglycerinated lymph, thus simplifying the process of vaccination.

"3. It does not coagulate, so that it never becomes necessary to discard a tube on this account.

"4. It can be produced absolutely free from the various streptococci and staphylococci which are usually to be found in untreated calf lymph, and which are, under certain circumstances, liable to occasion suppuration.

"5. The streptococcus of erysipelas is rapidly killed out by the germicidal action of the glycerine. The danger of 'late' erysipelas is diminished by reason of there being no necessity to open the mature vesicle for the purpose of obtaining lymph.

"6. The bacteriological purity and clinical activity of large quantities of the lymph can be readily tested prior to distribution."

But no one who knows the subject claims perfection for glycerinated virus. Many efforts to improve on it have been made, by using other germicides, and many more will doubtless be made, until something still more satisfactory can be discovered. In the meantime it is necessary for all who have to use vaccine to know just what can be expected with the present methods.

The Vaccine Lesions.

Let us now examine some of the peculiarities of the vaccine lesions. From the beginning it has been recognized that the vaccine pock presents peculiarities by which it can be distinguished from all other skin lesions, and especially from smallpox, varioloid and chicken-pox; and by which one can form some opinion as to the quality of the change produced in the organism by vaccination. In his first publication, Jenner gave

[112] some pictures that have always been accepted as of the greatest value. All of Jenner's contemporaries admitted the fidelity of the illustrations, and Cuff, who colored them, and who made others for later writers, insisted on their accuracy after he had seen many hundreds of lesions. I show lantern slides of these plates, viz.: The original cow-pox vesicle on the hand of Sarah Nelmes; a vesicle, the second remove from horse-pox; a vesicle in a late stage, the second remove from a vesicle on a cow, casually derived from horse-pox; a vesicle on the 9th day, from virus taken from the subject of the preceding. While these figures are very instructive, Jenner was justly criticised because he did not give a complete description, with illustrations, of the whole course of the disease. He made good the deficiency in 1801, when he published a set of illustrations by Cuff, which I also show. In the meantime Aikin, in England, and Ballhorn and Stromeyer, in Germany, had published illustrations, and these were followed by many others more or less perfectly executed. Waterhouse had an illustration made showing the appearance of the vesicle in the negro, an important aid in the development of vaccination in America.

I show next a copy of Sacco's illustration of cow-pox on the udder of a cow (after Rayer). Pfeiffer is probably right in thinking this was an inoculated cow-pox, not spontaneous, this belief being based on the distribution of the lesions. The vesicles are larger than those in trade vaccination. The next slides, Rayer's own pictures of the vaccine vesicle, are also of interest, on account of the general accuracy of Rayer's illustrations of skin lesions, and the influence the writer exerted upon medicine. I show also his pictures of atypical vaccination. Not less interesting are John D. Fisher's pictures, taken as they were from what were considered typical vesicles by men who remembered the earliest days of vaccination. The next series is that of Kirtland, made in 1802, and interesting because it shows the course of inoculated variola with that of vaccination at corresponding dates, but as it was not published until 1896 it did not affect the development of vaccination. Another valuable picture, historically, is that of Bousquet, showing the effects of recent virus from the cow-pox case of

1836, at Passy, compared with the old virus then used in [113] Paris.

Variations in the details and course of the vesicle have always been recognized as likely to occur, even with perfectly good virus, but on the other hand, marked departures in size, shape and course have always been considered as throwing the gravest doubt on the quality and also on the consequent immunity. Jenner insisted on the necessity of repeating vaccination until a perfect result was obtained. Recently, some doubt has been thrown on the essential nature of the areola, especially by makers of vaccine, and it might readily be supposed that this will not form after the use of virus of great bacterial purity. But I do not think we can abandon even this part of the local phenomena of vaccinia. In countries where most pains are taken to get good vaccine, and where its results are carefully followed and recorded, the areola is usually well-developed. I show some slides taken from cases inoculated by myself with American glycerinated virus of fair bacterial purity, but rather weak specific power, with well-developed areolæ. Incidentally, let me call attention to the method of inoculation, by single incisions, of which I shall speak later. The next and last picture I consider of great importance. It is from a photograph, and shows two lesions. These have dark roundish scabs with irregular surfaces, measuring 6 by 8 and 7 by 8 mm. respectively. Around each scab is a ring-shaped vesicle, from 1½ to 3 mm. wide. There is no distinct areola, but an unusally deep-looking narrow zone of redness and swelling, very unsymmetrically placed, strongly suggesting local infection. This photograph has been widely reproduced in advertisements as a representation of typical vaccine lesions. It differs radically from anything hitherto accepted as a typical lesion, and I shall have to speak of it later. It may serve to introduce the next division of my subject.

Some Aspects of American Vaccine Virus.

I must say at the outset that I do not intend to speak of all makes or makers of vaccine in the United States, but only of

[113] certain characteristics that I have found among a few rather conspicuous firms.

It might be supposed that makers of vaccine virus would not sell inferior preparations. Experience shows that this is not so. Dr. Rosenau, of the U. S. Public Health and Marine Hospital Service, who has examined virus for a long period, has shown that practically all the vaccine virus sold in this country has an unnecessarily large bacterial contamination, and although his observations show that improvements have taken place since he began his work, the results are still far from satisfactory. Rosenau charitably attributes the poor quality of the vaccine in part to over-confidence in the germicidal power of glycerine on the part of the makers. This, however, while charitable, is not altogether just. The makers had access to the literature, from which the actual capacity of glycerine to purify vaccine could have been obtained. Besides, the makers, particularly those I have in mind, made the most positive statements of purity, not only in advertisements, where such words as "aseptic" might have had a Pickwickian sense, but also in private correspondence, at the very time the virus, according to Rosenau's examinations, was very bad. It must be remembered that high bacterial contamination does not necessarily indicate dangerous infective possibility, but on the other hand it is believed by many that such an excess has a relation with the frequent secondary infections that occur from such virus. Then, too, the remarkable development of tetanus following vaccination, of two years ago, has been ascribed by MacFarland, long connected with the production of vaccine, partly at least to contaminated virus. Another explanation for the impurity of the virus is that sudden calls for large quantities compel the makers to put on the market "unripe" vaccine. In the present unregulated state of vaccination such demands are unavoidable. Systematic vaccination would do away with it. As it is now it would seem that policy, if not honesty, would lead the makers to declare the imperfection of the virus, just as some honest boards of health, unable to furnish pure water to cities, notify citizens when the contamination reaches a dangerous degree. Or, to

take a more commercial comparison, large demand does not [113]
excuse a butcher who for a similar reason sells spoiled meat.

The purity of American vaccine is not always as perfect as it should be; how is it about the specific power, or the capacity to confer immunity against small-pox? Much of it is seriously lacking in specific power. Some makers not only admit, but advertise as a point of excellence, that their vaccine does not produce an eruption. While they do not state in advertisements that scars are not left, I have heard the scientific manager of one large firm assert before a medical society that a scar is not necessary. Not only is there no proof of this, but, on the contrary, all the evidence we have goes to show that a certain scar, not too large, not too deep, and quite different from the scar following a slough or a phlegmon, is an essential part of the result of efficient vaccination. Another manager admitted to me that his firm aimed at getting the mildest possible result from vaccination. This they did, as my observations show, by reducing the specific action, for bacterial contamination was quite marked in many points and tubes I saw in use.

Weak specific action has an important bearing on the practical use of vaccination. With the best vaccine we expect to produce immunity lasting for several years, if not, as was once hoped, for a lifetime. Though small-pox, even fatal small-pox, may occur in some persons so vaccinated, yet the general resistance will be high. With less effective virus the immunity is shorter, from a few weeks to a few months, and on the whole very imperfect. At first glance it may seem that vaccine giving protection for even a month would be good enough, but more careful examination seriously alters the matter. If for no other reason, the production of a wound every few weeks would be not only dangerous, but would be more intolerable than the fear of small-pox itself. Moreover, vaccine that gives an abortive vesicle, indicating short duration of immunity, is often very slow in taking, up
to a month in one make, by the admission of one of the man- [114]
agers of the firm. But such vaccine would be useless in the face of actual danger, as has occurred so often in the last five

[114] years, and as is likely to occur, suddenly, many times in future before our laws are perfected.

Along with indifference to the production of pure and efficient vaccine, some of the makers of that material exert a positive influence for harm as extensive as it is insidious. In the advertising pages of scores of journals, and in countless circulars, not only are the advantages of the wares set forth in the usual language of advertisements, but questions of technic, of pathology and treatment are stated with impressive assurance. The photograph I showed illustrates some of these features. It is said to have been taken on the 8th day, but instead of showing the smooth umbilicated vesicle characteristic of that time, it shows a poorly developed vesicle surrounding a large dense scab. This is not the scab from drying of the contents of the vesicle, but is the result of necrosis of the skin, caused by extensive and deep scraping, part of the technic recommended by the firm. This method, if not original with makers of vaccine, owes its present vogue, I think, to the writings and pictures published by such firms, and to the demonstrations made by representatives of the firms, sometimes men of no medical training whatever. It is based upon a method formerly much used by physicians, and still recommended in some text-books, but according to the original method the denudation is very superficial, the epidermis is regenerated within a few hours, and the vaccine lesion goes on undisturbed by a necrotic mass over its place of inoculation. But the early scab is undesirable for other reasons than the very good one just mentioned. It favors accidental infection by rubbing with the nails or clothing, owing to its irritating qualities; it furnishes a good nidus for germs either originally in the skin, or introduced at the operation or later, and especially for those of tetanus. Many vaccine wounds have been so severe that boards of health have found it necessary to protest against them, and the Board of Health of Chicago has taken the pains to print a diagram one-eighth inch square as the largest abrasion compatible with safety. It would be much better to prohibit such an operation entirely, as has been the law in Germany for several years. As my own photographs show, clean superficial incisions will

permit the virus to take, if it is potent, and it is obvious that [114] if such incisions do not heal by primary union, there is at least but little irritating and septic material in them.

The history of the photograph with the hard scab also illustrates other aspects of the vaccine trade, viz., the possibility of lack of special knowledge of vaccinia on the part of the makers, and the differences of interest of the so-called biologic department and the counting-room. The gentleman in charge of the former was not aware of the difference between a depression caused by an early scab, and the characteristic umbilication of the genuine vesicle. In a letter replying to my criticism of the picture he wrote: "I saw these vaccinations just before they were photographed, and, in my opinion, they are very nearly typical for the age of the lesions." He also asserted that his firm had never sent out any other pictures of vaccine lesions, and quoted employees of the publication department to prove the statement, though I was able to show him a picture sent out as a circular by his firm, in which a group of abortive conoidal vesicles was reproduced as an illustration of the successful use of the virus.

I mention this experience as an evidence of the need of some better arrangements for the production of vaccine virus than we now possess, an arrangement by which the material would become less a commodity to be turned out according to the inclinations of those who know nothing and care little for any other than its selling qualities, and more the subject of careful elaboration and well-directed effort at improvement. Copeman makes the interesting statement that in the vaccine institutions he visited in Europe researches were being made tending to improve the quality of vaccine. Medical literature bears witness to the scientific activity of these institutions, but in this country the only originality exhibited is limited to details of packing.

It is too often forgotten that vaccination is a public rather than a private benefit. Its real object is not merely to prevent sickness or death in individuals, but to prevent epidemics with all their numerous and widespread consequences. This is the reason why some countries have adopted general vac-

[114] cination, and the reason why in this country, without a well-planned regulation, measures are adopted in times of danger that aim at compulsory and general vaccination, but for various reasons often fail.

If people voluntarily adopt general vaccination, they are not likely to continue the practice unless the operation is reasonably mild and safe, and the protection fairly certain. As more or less compulsory vaccination is likely to be necessary for a long time to come, it would seem essential that the power compelling the operation should guarantee the purity of material and the safety of the operation.

For this, either public manufacture or public inspection are necessary. Inspection as carried out for the last two years under the Public Health and Marine Hospital Service has done some good, but as the results are published without names much of the value of the examinations is lost, and no test of specific activity is attempted. It is often said that such control is impossible under our system of government, but this objection is more theoretical than real. If the general government can furnish pure seed to farmers, and the separate States regulate the sale of oleomargarine, the inspection of oil, salt, etc., or the sale of alcoholics and tobacco, vaccine could easily be put under public control, provided, of course, that the wishes of the people were not thwarted by the unseen but powerful influence of lobbies supported by those who prefer to keep the industry in their own hands. The details of such public control are beyond the scope of this paper, which aims rather at exciting an interest in the practice of vaccination and its accurate and careful study.